

PROPERTIES OF CAST TITANIUM ALLOYS PRODUCED BY ELECTRON-BEAM SKULL MELTING TECHNOLOGY

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The results of the investigation of VT1-0 (technical clean titanium), VT5 (Ti - 4.3...6.2% Al), VT20 (Ti - 5.5...7.7% Al - 1.5...2.0% Mo - 0.8...2.3% V - 1.5...2.5% Zr), VT3-1 (Ti - 5.5...7.0% Al - 2.0...3.0% Mo - 0.8...2.3% Cr - 0.15...0.4% Si - 0.2...0.7% Fe) and VT23 (Ti - 3.5...7.0% Al - 2.0...3.0% Mo - 3.5...5.0% V - 0.8...2.3% Cr - 0.15...0.4% Si - 0.5...1.5% Fe) titanium alloys production with the use of the electron-beam skull melting (EBSM) technology with the electromagnetic stirring (EMS) of melt are described.

Cast waste and shaving were used as charge. Samples for the metal properties investigation were cast in metal molds and had 10-100 mm in diameter.

The maximal electron-beam power was 80 kW at the time of melting from 20 to 28 min. The melt mass was 4.2-4.6 kg. Electromagnetic stirring of melt lasted 12-15 min at the end of melting; the speed of the melt movement was about 0.4 m/s. The specific electric energy consumption was changed from 3.7 to 5.5 kW·hour/kg depending on the type of the charge.

Results of the comparative analysis of mechanical properties of EBSM alloys and those of vacuum-arc remelting (VAR) deformed metal are given in the Table.

MECHANICAL PROPERTIES OF Ti BASED ALLOYS

| Alloy | State (method of melting) | Properties | | | | |
|-------|---------------------------------|-------------|-----------------|---------------|---------------------------|------------|
| | | UTS, MPa | δ , % | Ψ , % | KCU, kJ/m ² | HB, MPa |
| VT1-0 | As cast (EBSM) | 415-590 | 12-24 | 32-50 | 820-940 | 1600-1900 |
| | Deformed (VAR) | 355-540 | 19 | 38 | 1000 | 1300-1600 |
| VT5 | As cast (EBSM) | 780-820 | 9-14 | 28-32 | 480-620 | 2300-2600 |
| | Deformed (VAR) | 750-950 | 10 | 25 | 300-500 | 2290-3210 |
| VT20 | As cast (EBSM) | 980-1030 | 8-11 | 15-24 | 410-480 | 3100-3300 |
| | Deformed (VAR) | 1000-1100 | 10-13 | 20-36 | - | - |
| VT3-1 | As cast (EBSM) | 1080-1100 | 7-15 | 12-24 | 340-360 | 3300-3520 |
| | Deformed (VAR) | 1000-1200 | 10 | 30 | 300 | 2690-3630 |
| VT23 | As cast (EBSM) | 1130-1150 | 3-7 | 6-12 | 250-260 | 3500-3700 |
| | Deformed (VAR) | 1100 | 14 | - | - | - |

Note: The properties of deformed alloys agree with the State standard.

The investigations conducted prove that the EBSM with EMS allows ensuring that the properties of titanium alloys in the cast state equal those of deformed metal produced by conventional VAR technology. The new technology allows to use cast alloys rather than the deformed for example in the production of items for medical purposes.

Key words: titanium, alloy, electron-beam skull melting, mechanical properties, as cast, deformed.